Pb 1000

RPM's copy with notes

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Attach Fig. 3.5 from RI & stress "equates to" on other isopleths.

To: Scott Brown, U.S.E.P.A., Helena, MT.

From: Douglas J. Dollhopf, Pam Blicker and Dennis Neuman

Re: **Estimated Area In Helena Valley Where Total Soil Lead Concentrations Exceed 1000 mg/kg (Map 1).**

Objective

•Identify areas in the Helena Valley where the total soil lead concentration may exceed 1000 mg/kg as a function of a specified probability.

Results are exhibited on attached Map 1. Support calculations are presented below.

Literature Used In Support Of These Following Calculations

CH2M Hill. 1987. Remedial investigation of soils, vegetation and livestock for the East Helena site (ASARCO), East Helena, Montana. U.S.E.P.A., Helena, MT., pages 3.46-3.52.

Area Where Total Soil Lead Concentration Is Greater Than 1000 mg/kg

Using geostatistics, a semivariogram and associated kriged maps (Figures 3.4 and 3.5, CH2M Hill 1987) were prepared that depicted total soil lead across the Helena Valley for the 0-4 inch depth increment. The following calculations were developed to determine the area within the Helena Valley where there is less than a 2.5 % probability that total soil lead concentration is greater than 1000 mg/kg. Total soil lead values used for this analysis are presented in Appendix Table 1.

Less Than 2.5 % Probability Calculation

•On Figure 3.5, the area encompassed by the 3.0 ($\log_{10}$) isopleth line is composed almost entirely of soils having greater than 1000 mg/kg total lead. Total soil lead concentrations greater than 1000 mg/kg will be encountered outside the 3.0 ($\log_{10}$) isopleth line, but there is less than a 2.5 % probability of locating such soil concentrations outside the 2.53 ($\log_{10}$) isopleth line on Figure 3.5. The 2.53 ($\log_{10}$) isopleth line equates to a total soil lead concentration of 339 mg/kg. The calculation in support of this finding follows.

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Discuss w Doug & Dennis: Exposure Unit concept

•One tailed t-value @ n = 157 @ 97.5 % confidence = 1.96
As shown on Figure 3.4, a standard error of 0.24 is appropriate to use for the soil area containing greater than 1000 mg/kg Pb.
$2.53 + (0.24)(1.96) = 3.0$
$10^{3.0} = 1000$ mg/kg Pb

In Figure 3.5, the isopleth line labeled 2.53 ($\log_{10}$) encompasses an area of 2813 acres, approximately 2.5 by 2.5 miles, beyond which there is less than a 2.5 % probability of locating a soil concentration greater than 1000 mg/kg.

A Note Of Caution

This kriged map can be used to provide guidance on soil lead concentrations across the Helena Valley and to aid in design of field sampling efforts. Although statistical levels of confidence can be calculated for lead concentration lines shown on Figure 3.5, caution should be exercised when making an interpretation. This map was developed using a predictive model based on 157 soil samples across the Helena Valley. Because cleanup decisions for individual properties need to be based on exact boundaries of soil arsenic concentrations, additional soil sampling and associated laboratory analysis must be done to define these boundaries with higher levels of confidence.

Also, note that these results are for the 0-4 inch soil depth increment. The Helena Valley area where total soil lead concentrations exceed 1000 mg/kg may yield a different result if the soil sampling depth was changed.

2,813 ÷ 640 = 4.4
2.5 x 2.5 = 6.25


irreg., circular polygon
vs

square

Appendix Table 1. Total soil arsenic (As) and lead (Pb) in the 0-4 inch depth increment at sites in the Helena Valley. These data are from the 1987 Remedial Investigation Of Soils, Vegetation And Livestock, East Helena, MT prepared by CH2M Hill for the U.S. EPA, Helena, MT.

	As	Pb
SITE	mg/kg	
4	42.00	63.00
5	21.00	35.00
6	20.00	13.00
7	16.00	55.00
8	24.00	45.00
9	85.00	58.00
10	25.00	71.70
11	21.50	58.00
12	35.00	234.00
13	27.00	55.00
14	28.00	41.00
15	24.00	80.00
16	27.00	150.00
17	130.00	300.00
18	21.00	65.00
19	23.00	175.00
20	37.00	308.00
21	23.00	70.00
22	31.00	183.00
23	27.00	179.00
24	30.50	120.00
25	60.00	70.00
26	30.00	111.00
27	26.00	136.00
28	26.00	160.00
29	25.00	95.00
30	32.50	311.00
31	27.00	323.00
32	19.00	262.00
33	35.00	317.00
34	50.00	27.60
35	29.00	70.00
36	121.50	128.00
37	24.00	159.00
38	34.00	323.00
39	32.50	166.00
40	28.00	134.00

SITE	As	Pb
	mg/kg	
41	110.00	620.00
42	41.00	630.00
43	46.00	373.00
44	35.00	250.00
45	38.00	118.00
46	37.00	202.00
47	23.00	159.00
48	42.00	269.00
49	40.00	184.00
50	60.00	496.00
51	100.00	1000.00
52	340.00	8300.00
53	101.00	126.00
54	27.00	225.00
55	50.00	670.00
56	139.00	1350.00
57	44.00	378.00
58	26.50	76.00
59	20.00	19.00
60	18.00	37.50
62	44.00	510.00
63	60.00	742.00
64	26.00	230.00
65	110.00	1100.00
66	333.00	5900.00
67	570.00	2160.00
68	106.50	1317.00
69	65.00	417.00
70	65.00	336.00
71	21.00	191.00
72	31.00	190.00
73	34.00	42.00
74	60.00	242.00
75	29.00	168.00
76	31.00	330.00
77	55.00	455.00
78	119.00	660.00
79	188.00	2190.00
82	40.00	1130.00
83	28.00	191.00
84	95.00	793.00

SITE	As	Pb
	mg/kg	
86	65.00	254.00
87	55.00	260.00
88	55.00	318.00
90	50.00	324.00
91	65.00	550.00
92	50.00	363.00
93	45.00	630.00
95	100.00	900.00
96	140.00	1000.00
98	50.00	500.00
99	30.00	234.00
100	70.00	533.00
101	90.00	344.00
102	38.00	226.00
103	37.00	224.00
105	65.00	482.00
106	163.50	1079.00
107	46.00	405.00
108	44.00	316.00
109	55.00	378.00
110	50.00	430.00
111	30.50	185.00
112	25.00	169.00
113	36.00	345.00
114	40.00	179.00
115	25.00	164.00
116	25.00	187.00
117	39.00	300.00
118	26.00	246.00
119	55.00	317.00
121	43.00	600.00
122	85.00	570.00
123	75.00	430.00
124	50.00	287.00
125	60.00	346.00
126	43.00	84.00
128	60.00	460.00
129	75.00	554.45
130	55.00	350.00
131	32.00	216.00
132	24.00	254.00

SITE	As	Pb
	mg/kg	
133	24.00	164.00
134	22.50	136.15
135	36.00	42.00
136	18.50	38.25
137	26.00	113.00
138	60.00	396.00
139	95.00	416.00
140	35.00	346.00
141	60.00	623.00
142	48.00	320.00
143	55.00	425.00
144	39.00	210.00
145	44.00	313.00
146	65.00	360.00
147	40.00	255.00
148	65.00	285.00
149	55.00	128.00
150	49.00	114.00
151	70.00	148.25
152	16.00	80.00
153	33.00	200.00
154	26.00	66.00
156	15.50	30.00
157	18.00	25.60
158	13.00	26.00
159	37.00	75.00
160	26.50	130.00
161	56.76	107.00
162	27.00	118.00
163	16.00	57.00
164	50.00	73.00
165	16.50	63.00
166	45.00	70.00
167	33.50	39.70